Bengaluru Metropolitan Transport Corporation

Shanthinagar, Bengaluru-570027.

Tender No. BMTC/2023-24/SE0280/CALL-2 dtd.14.03.2024

Selection of Service Provider for Procurement, Operation and Maintenance of 10 Nos. double decker AC Electric Buses on Gross Cost Contract (GCC) Model under National Clean Air Programme (NCAP) and State Urban Transport Fund (SUTF) of Directorate of Urban Land Transport (DULT).

VOLUME - II

SPECIFICATIONS

Bengaluru Metropolitan Transport Corporation

The buses shall be complaint to AIS-139, AIS-052, 140, 153 and AIS-049 as amended time to time. The homologation certificate should be provided during the supply of prototype bus and the technical specifications required are as below:

Sl No.	Description	Technical Specification
	Bus characteristics Maximum Bus Floor height	900 mm
1	Propulsion system	Electric mode
2	Type of Battery	Li-ion or Li-ion Phosphate Battery or Li NMC or superior as per manufacturer's design
3	Battery pack rating and energy / power available for propulsion; Any deterioration in propulsion power with usage and consequently reducing charge; Min & max charging % Maximum Thirty Minutes Power (kW) Motor/s capacity	• Maximum Thirty Minutes Power (kW) • It should be sufficient to provide requirements of Power, acceleration, maximum speed, and rated performance as per UBS II. • The battery shall have capacity to operate daily assured kilometers of 120kms in a single charge at 80% SOC and after opportunity charging of 45 minutes at same identified depot, so that assured kilometers of 150 per day is achieved (on actual condition with GVW and AC). • No of Motors/ batteries as per the Bus Manufacturer's design. • Electrical Regeneration required. • Charging mode: DC charging required. • OFF board or ON-board charging required. • Charging time: 1–2 hours. • Battery power consumption less than 1.8 kwh per kilometer. • Safety: Short circuit /over temperature • Safety requirement for Electric buses shall meet as per AIS 038 (CMVR) • CMVR certification mandatory • It should be waterproof as per applicable standard code.
3.1	Battery cooling system	Efficient and robust battery cooling system calling for minimum maintenance or as per Bus manufacturer's design.
3.2	Battery life	The manufacturers to replace batteries when the state of health (SOH) fall below

		80 percent.
3.3	Battery Charging System	DC fast charging by CCS 2.0 or as per Bus manufacturer’s design.
3.4	Electric drive motor/s	Optimal rating, type, make, model of electric drive motor requiring minimum maintenance
3.5	Electric Propulsion System	Electric propulsion system motor rating / power sufficient to provide:
A	Rated performance at GVW in a stop/start urban operations	Geared maximum speed without speed limiter to be 75 kmph (without speed limiter) at GVW load, air conditioning and other sub-system operational
B	Acceleration (meter/sec^2)	As per AIS: 153
C	Maximum speed	As per CMVR
D	Minimum Operation Range per bus per day for the first 5 years	The battery shall have capacity to operate daily assured kilometers of 120kms in a single charge at 80% SOC and after opportunity charging of 45 minutes at same identified depot, so that assured kilometers of 150 per day is achieved (on actual condition with GVW and AC).
E	Grade ability from stop at GVW	17%
F	Rated HP/torque preferably at lower rpm range	Maximum torque required at lower range of RPM and spread over a wider range of RPM Sufficient torque to meet the acceleration, AC and range requirement.
G	Pass by noise norms	As per CMVR& bus code
H	Electric propulsion system	SOC with Vehicle Health Monitoring System. (Battery health + regenerative brake charging)
I	Electric propulsion system /operational requirements	Electric propulsion system should be able to operate efficiently at ambient temperatures / environmental conditions of urban and sub-urban areas
J	Electric propulsion system / subsystems location	Manufacturer may decide the location.
4	Transmission	Automatic / Drive or as per Bus manufacturer’s design.
5	Operational safety	Transmission system to be fitted with a mechanism which makes it possible to engage reverse gear only when vehicle is stationary (applicable for automatic & automatic manual transmission), if fitted or as per Bus manufacturer’s design.

6	Rear axle	Single reduction, hypoid gears, full floating axle shafts with optimal gear ratios suitable for urban operations (To be considered as a guideline) or as per Bus manufacturer's design.
7	Front axle	Heavy duty reverse Elliot type axle suitable for various floor heights or as per Bus manufacturer's design.
8	Steering system	Hydraulic power steering with height and angle adjustment/ Hydraulic power steering without height and angle adjustment or as per Bus manufacturer's design.
9	Suspension system	
9.1	Front	As per manufacturer design
9.2	Rear	As per manufacturer design
9.3	Anti-roll bars/stabilizers	Required at front and rear
9.4	Shock absorbers	Hydraulic double acting 2 at front & 2/4 at rear or as per manufacturer design.
9.5	Kneeling (mm) applicable in case of air suspension	Not applicable
9.6	Controls (optional)	Electronically controlled air suspension system or as per Bus manufacturer's design.
10	Braking system	Mandatory ABS with Disc at front and Drum at rear OR disc brake at front and rear or as per Bus manufacturer's design.
10.1	Anti-skid anti-brake locking system (ABS)	Mandatory.
10.2	Electronic controls	AS per manufacturers design
11	Electrical system	24-volt DC
11.1	Batteries (ancillaries equipment and light and light signaling devices)	Low maintenance type lead acid batteries for 24 V & Min100Ah system- performances as per BIS: 14257-1995(latest). 2X12V of commensurate capacity. Maintenance free batteries preferred. (latest)
11.2	Electrical wiring & controls -type	Multiplexing type -- As specified separately under ITS specifications and conforming to IP 65/67. As per UBS II and AIS 153
10	Speed limiting device	Mandatory as per CMVR
12	Tyres	Steel radial tube-less. Size and performance as per CMVR or as per Bus manufacturer's design.
13	Operating Range:	The battery shall have capacity to operate daily assured kilometers of 150kms at 80% SOC for DD AC Buses in actual conditions for the relevant GVW with Air Conditioning.
14	Bus characteristics	

14.1	Bus dimensions (mm)	
A	Overall length (excluding bumper)	9.5 m to 11.00 m
B	Overall width (sole bar/floor level- extreme points)	As per CMVR
C	Overall height (unladen - at extreme point)	As per CMVR
D	Wheelbase	As per Bus manufacturer’s design.
1	Front Overhang	As per CMVR
2	Rear Overhang	As per CMVR
14.2	Maximum turning circle radius (mm)	As per CMVR
14.3	Floor height above ground (mm)	900 mm
14.4	Clearances (mm)	
A	Minimum Axle clearance (mm)	Minimum 175 mm or as per Bus manufacturer’s design.
B	Wheel area clearance (mm)	> 220 mm for parts fixed to bus body &> 170 mm for the parts moving vertically with axle or as per Bus manufacturer’s design.
C	Minimum ground clearance (un-kneeled) at GVW	Within the wheelbase not less than 240mm.
14.5	Angles (degrees)	
A	Angle of approach (unladen)	Not less than 8.5°OR as per CMVR / AIS 052
B	Angle of departure (unladen)	Not less than 9.0°OR as per CMVR / AIS 052
C	Ramp over angle (half of break-over angle)	Not less than 4.8°OR as per CMVR / AIS 052
15	Bus Gates/Doors	
15.1	Type of doors	Power operated doors, Front & Rear Door: JK doors or as per Bus manufacturer’s design.
A	Operating mechanism	Electro pneumatically controlled or as per Bus manufacturer’s design.
B	Opening/Closing time in seconds per operation (maximum)	4
C	Positions of door controls	On dashboard and inside & outside of doors as per AIS 052.
D	Passenger safety	Mandatory

	system - allowing bus motion on doors closing and doors opening only when the bus is stopped	
15.2	Front service doors	
A	Minimum door aperture (Without flaps) in mm	800mm or As per AIS 052
B	Minimum clear door width (Fully opened) in mm	650 ± 50
C	Minimum door height in mm	1900mm
D	Positioning front service gate	Behind the front axle
E	Number of gates	1
15.3	Rear service doors	
15.3.1	Rear service doors location	Preferably behind rear axle
15.3.2	Rear service doors -	
A	Minimum door aperture (Without flaps) in mm	Minimum 1200 mm or as per AIS 052
B	Minimum clear door width (Fully opened) in mm	Minimum 1000 mm or as per AIS 052
C	Minimum Door height in mm	1900 or as per AIS 052
D	Positioning rear door	Behind rear axle
E	Number of gates	1
15.4	Maximum first step height (mm) from ground unladen & unkneeled position in buses with:	
A	Stepped type entry (maximum)	400 mm or as per AIS 052
15.5	Maximum height (mm) of other steps (where required)	
A	if door ahead of rear axle	250 mm (applicable only for 900 mm floor ht. buses) or as per AIS 052
B	if door behind rear axle	250 mm or as per AIS 052
15.6	Ramp for wheelchair at the gates	Not required
A	Dimensions	

B	Material	
C	Load carrying capacity (in kilograms)	
D	Device to prevent the wheelchair roll off the sides when the length exceeds 1200mm	
E	Device to lock wrapped up ramp	
F	Kneel ramp control: (Applicable in reference of clause 7.3)	
G	Requirement for passengers with limited mobility	
1	Wheelchair anchoring - minimum for one-wheel chair	Not required
2	Priority seats - minimum 2 seats	Required, location as per BMTC requirement
H	Emergency doors/exits or apertures (Numbers)	As per AIS 052 and as per AIS 153.
	Dimensions in mm	As per AIS 052 and as per AIS 153.
	Intercommunication staircase	One intercommunication staircase from boarding platform to upper deck One half staircase from lower deck to upper deck or As per AIS 139
I	Door closing requirements for bus movement -	Bus could move only after door closing completed
1	Power operated service door - construction & control system of a power operated service door to be such that a Passenger is unlikely to be injured/trapped between the doors while closing.	As per AIS 052
2	Door components	As per AIS 052
3	Door locks/locking systems/door retention items	As per AIS 052
4	Door hinges	As per AIS 052
16	Bus body	
16.1	Design type approval	As per CMVR + Annexure 3 of UBS II +

		AIS:052 + AIS:153 +AIS:139 Design type certificate of testing agency required to submit at time of prototype bus inspection
16.2	Bus structure - materials specifications etc.	As per manufacturers design
16.3	Insulation	FR grade material as per IS 15061
A	Roof and side	FR Grade material glass wool, PU foam or thermocole.
B	Battery pack compartment	As per AIS:052.
16.4	Floor type/Materials etc.	
A	Type of Floor	As per AIS:052 requirements.
B	Steps on floor	As per AIS:052 requirements.
C	Maximum floor slope	As per Bus AIS:052
D	Floor surface material	12 mm thickness phenolic resin bonded densified laminated compressed wooden floorboard (both side plain surface) having density of 1.2 gms/cc conforming to IS3513 (Part-3): type VI 1989 or latest. The flooring should also be boiling water resistant as for marine boardBIS:710-1976/ latest and fire retardant as per BIS:5509-2000 (IS15061:2002) or Chequered Plywood 12mm/19mmthick
E	Anti – skid material	3 mm thick anti-skid type silicon grains ISO 877/76 for colour, IS5509 for fire retardancy
16.5	Safety glasses and fittings:	
A	Front windscreen (laminated) glass:	Single piece laminated safety glass, plain, flat/curved with curved corners with PVB film IS 2553 (Part-2)- 1992/latest. Standard designs for each variant of buses to be followed. (Refer Annexure 1 of UBS-II) or As per Manufacturer design
B	Rear windscreen glass	Single piece flat/curved toughened glass-plain/flat/curved at centre &curved at corners – IS 2553 (Part 2) –1992/Latest. Single piece flat / curved pasted glasses or As per Manufacturer design
C	Side windows:	Flat, 2-piece design-top fixed/sliding & bottom sliding toughened glass IS2553 (Part-2)-1992/latest OR Single piece flat/curved pasted glass or As per Manufacturer design
D	Glass specifications	Toughened glass IS2553 (Part-2)-1992/latest

	Glass thickness:	4.8-5.3mm
E	Window & other glasses - material specs, thickness etc.	Toughened as per IS:2553 (Part-2)–1992/latest of 4.8-5.3mm thickness
F	Safety glass	As per CMVR
G	Rear view mirrors	As per CMVR
16.6	Seating and gangway etc.	
16.6.1	Passenger seating for ordinary type-1 buses	As per AIS 052
A	Seat layout in the lower deck	2x2
B	Seat layout in the upper deck	2x2
C	Seat area/seat space per Passenger (width*depth) mm	400X350
D	Seat pitch - minimum (mm)	As per AIS 052
E	Minimum backrest height from floor to top of seat/headrest	As per AIS 052
	Seat base height- distance from floor to horizontal front upper surface of seat cushion mm.	As per AIS 052
	Seat back rest height mm	As per AIS:023
F	Torso angle (degrees)	Minimum 12degree
G	Seat materials	PPLD/LDPE moulded As per AIS:023 & AIS 052 for performance
H	Seat frame structure material where required:	As per AIS: 023 + Frame structure of ERW steel tube, seat tops shall have arrangement of fastening of lower end of vertical stanchions.
I	Free height over seating position (mm)	More than 900 as per AIS:052
	Seat base height:	As per AIS 052
J	Clearance space for seated Passenger facing partition (mm)	Minimum 350

K	Seat back/Pad material/Thickness:	Polyurethane Foam IS: 15061:2002
	Type:	MDI Moulded IS: 5509
	Upholstery:	Pile Fabric/Jekard 0.7-1.0 mm thickness
L	Area for seated passengers (sq. mm.) type 1	400X350
M	Area for standee passengers (sq. mm.):	As per AIS 052
N	Number of seats	Min 63 seats + driver
O	Number of standees	Calculation as per AIS 052
P	Headrest	Not required
Q	Seats side facing location	Not required except seats on wheel housings only if required
R	Seat arm	Seats opposite to service door and above wheel arches.
S	Individual seat row fans	Not required
T	Seat back rest	Fixed
U	Seat belts & their anchorage	As per CMVR
V	Performance & strength requirements of:	Required
i	Driver seat	As per AIS 023
ii	Passenger seats	As per AIS 023
16.6.2	Gangway:	
A	Minimum interior height (Centre line of gangway)	As per AIS 139
B	Gangway width (mm)	Minimum 600 mm, will be measured from seat edge to seat edge.
E	Driver’s work area	As per AIS 052
F	Driver’s seat	As per AIS 023
17	Electrical system	As per CMVR & as per AIS 153. BIS marked, copper conductors with fire retardant as per IS/ISO: 6722:2006 as per appropriate class. conductor x-sec varying as per circuit requirements, minimum cross-section0.5 sq. mm. quality marking may also be as per equivalent or better European, Japanese, US standards conforming to IP 67 Water & airtight for traction battery. For bus body building, multiplex wiring/ISO 6722.
17.1	Safety requirements of electrical	
A	Fuse	As per AIS 052
B	Isolation switches for	As per AIS 052

	electrical circuits where RMS value of voltage exceeds 100 volts	
C	Location of cables away from heat sources	As per AIS 052
D	Type approval of circuit diagram as per standards related to electric equipment's/wiring	As per AIS 052
E	Battery cut - off switch (Isolator switch):	As per manufacturer design
17.2	Wind screen wiper:	As per CMVR: IS 15802
A	Wiper motor:	
B	Wiper arm/blade:	
17.3	Driver cabin fan	Required.
17.4	Lighting - internal & external and illumination	As per AIS 052 and AIS 153
17.5	Illumination requirements/ performance of:	
A	Dashboard tell-tale lighting/control lighting	As per AIS 052
B	Cabin lighting - luminous flux of all lamps for cabin lighting	As per AIS 052 and AIS 153
C	Passenger area lighting - luminous flux of all lamps for Passenger area lighting	As per AIS 052 and AIS 153
18	ITS on bus	1) Compliance to AIS 140 2) Passenger Information system (PIS) consisting of three route/destination LED external display boards (front, rear and side) sizes as per AIS052, and one at lower and one at upper deck internal display boards as per AIS052 along with passenger announcement system 3) Security camera network (SCN) : Total five cameras; with two camera in lower deck, two cameras in upper deck & one reverse back camera with 48 hrs recording as per ISI 16833 4) VTS/panic button shall be as per AIS 140, Panic button shall be provided in each

		row of seat on RH and LH Or As per AIS 140
19	Safety related items:	
19.1	Driver seat belt & anchorage duly type approved.	ELR recoil type, 3-point mounting as per CMVR & AIS 052 conforming to AIS 005 & 015
19.2	Fire extinguisher:	As per AIS 052
19.3	First aid box:	1 number, as per provision of CMVR
19.4	Handrails minimum length*diameter*height above floor in mm	Colour contrasting and slip resistant of aluminium tubing32 mm dia, 3 mm thick. rest as per AIS 052 OR MS tubing with sleeves or as per manufacturer design
19.5	Handholds:	Colour contrasting and slip resistant. 2 to 4 numbers. Handholds per bay. Rest as per AIS 052 or as per manufacturer design
19.6	Stanchions:	As per manufacturer design
19.7	Window guardrails:	NA
19.8	Entrance/Exit guard/Step well guard:	800 mm minimum height extending ≥ 100mm more than centre line of sitting position of the Passenger.
19.9	Emergency exit doors, warning devices etc.:	R H Side emergency door mandatory Dimensions as per AIS 052/CMVR
19.10	Front/Rear door, step well lights, door open sign	As per AIS 052
19.11	Mirrors right/left side exterior/interior:	As per AIS: 001 & 002. Interior with double curvature
19.12	Towing device front/rear	Heavy duty 1.2 times (minimum) the kerb weight of the bus with 30 of the longitudinal axis of the bus. As per CMVR & IS 9760 - ring type Towing device front required
19.13	Warning triangle	As per CMVR
19.14	Bumpers - front and rear	Both made of steel or impact resistant polymer or combination of both meeting requirement of an energy absorbing system. FRP As per CMVR and AIS 052. Or as er manufacturer design
	Impact strength for bumpers	As per AIS 052
20	Miscellaneous items/requirements	
20.1	Windows	
A	Type of window	Windows are pasted / as per AIS 052 (AC)
B	Minimum height of window aperture in mm	As per AIS 052

C	Minimum height of upper edge of window aperture from bus floor	As per AIS 052
D	Minimum width of windows (clear vision zone)	As per AIS 052
20.2	Life cycle requirements of bus	12 years or 10,00,000 km
21	Maximum noise levels inside the saloon - test procedure as per AIS 020	As per requirement of AIS:153
22	Air conditioning system – Test procedure for type approval	As per UBS -II
22.1	Specification	a) For up to 42°C of saloon temperature and b) For > 42°C of saloon temperature
22.2	Target result	a) 24± 4°C (up to 42°C) b) Temperature gradient of 15° (> 42°C of saloon temperature) e.g. If the saloon temperature is 45˚, then the target temperature inside the bus is 45˚-15˚= 30˚. c)Minimum average air velocity at air vent is 4.5 m/s.
22.3	Apparatus	Lab condition and heating chamber
22.4	Procedure	1. Soak for 1 hour 2. At 2000 rpm 3. Upto 42°C: pull down time 30 minutes(maximum) (for more than42°C of saloon temperature, pull down time within 40 minutes (maximum)) 4. Thermocouple to be placed over place minimum 20 numbers at nose level
22.5	Air Curtains on entry/exit gates to avoid loss/gain of heat and or cool air when doors are frequently opened for boarding/alighting of Passenger with min air flow of 1000±50 m^3/hr at each gate. Type of	Not required

	air curtains at entry exit gates their power consumption etc be accounted for while deciding engine power, etc	
23	Air circulations and ventilation in driver's area	Blower motor to be provided in driver cabin.
		Drivers work area to be provided with blower or suitable device (200 mm diameter fan) to ensure proper ventilation. These devices may be capable of 3 – speed adjustment or as per manufacturer design
24	Maximum noise levels inside the saloon (Irrespective of AC, non-AC/fuel type/engine location)-test procedure as per AIS 020	As per the requirement of AIS 153.
25	Paint	Colour scheme as per BMTC requirement

Note:

I. The Bidder shall submit Technical Specification of Components/Systems of Electric Propulsion system and submit the test certificate for these components as per the prescribed standards from the notified testing agencies like CIRT, ARAI, VRDE, etc.

II. All electrical wiring harness and accessories used on electric bus shall comply necessary automotive safety standards.

III. All units & electrical accessories and wiring harnesses used on the bus shall be so mounted that they are easily accessible and can be removed without disturbing other components. Further these accessories and wiring harnesses shall be well protected to prevent ingress of water.

IV. Mandatory Certification Compliance and acceptance tests for Safety Components, Batteries, Buses and Requirements for Battery Charging Infrastructure Systems etc. by competent authority to be obtained.

V. Mandatory Certification Compliance for Safety Components, Batteries &Buses should be met

VI. The Bidder shall ensure the fitment of all electric propulsion system components on the bus confirming to National/International Standards.

VII. The Buses shall meet all the above technical specification requirements. The buses shall be deemed satisfactory for operation only after the buses meet all the requirements prescribed above.

VIII. Manufacturers need to meet high safety standards for battery packs. These standards include a protection level that is no less than

IP67—which represents a high water and dustproof battery pack—and satisfactory operation safety in extreme temperatures ranging from minus 20°C to 65°C.

IX. Manufacturers are also required to build in automatic fire extinguishing devices to protect passengers and drivers in case of fire incidents.

ATD, Cameras and MNVR Specifications

(i) Automatic Tracking Device and Emergency Button Specifications

The Automatic Tracking Device (ATD) and Emergency Buttons should be fully compliant to AIS 140standard (as amended from time to time) and should be type approved from testing agencies authorized under CMVR.

In addition to above, the ATD should meet the following requirements:

i. The ATD shall provide the output as per NMEA0183 for GPRMC packets to PIS controller through RS232 at minimum frequency of 1 Hz.
ii. ATD should support Over the Air (OTA) firmware and configurationally parameter updation.
iii. ATD should send device health monitoring parameters.
iv. ATD should send location data @ 10 seconds during bus ignition on and @1 minutes when bus ignition off.
v. ATD should have inbuilt battery with a backup of at-least one hour
vi. ATD should come with normal SIM slot with single carrier communication/ e-SIM.
vii. On pressing of any of emergency button the emergency alert should be sent to the configured IP address. In the absence of GPRS network, the alert should be sent as SMS.

(ii) In- bus Camera

Sl no	Parameter	Minimum Specifications
1	No of cameras	5
2	Power Supply	PoE through MNVR, should be automatically switched on with engine and power down on ignition off.
3	Camera feed display	Relay feed to control center on demand. Web viewer, cloud enabled CMS(DSS/Smart PSS) & DMSS
4	Camera recording duration	40 hours in-built recording storage capability
5	Fixed lens	3.6 mm
6	Picture Resolution	752 H x 582 V (PAL)
7	Resolution	25/30fps@1080P
8	Picture Sensor	1/3” 2Megapixel progressive scan Aptina CMOS,

Sl no	Parameter	Minimum Specifications
9	IR distance	Min 30 m
10	Image Enhancement	DWDR, Day/Night(ICR), 3DNR,AWB,AGC,BLC
11	Video and Audio Compression	The IP camera shall support H.264/ 265 video compression and G.711 or G.726 audio compression
12	Protection	Minimum IP 66
13	IP Camera	Yes
14	Temperature	-10 deg C to + 60 deg C
15	Humidity	5% to 95 %
16	Vibrations	10g
17	Motion detection	Automatic
18	Camera Ruggedness	Rugged, vibration, shock and tamper proof Metal housing, Aviation Connectors Installation :Anti Vibration with Adjust Angle; Ø Horizontal: 0~355 degree with 3-point locking Ø Vertical:0~90 degree with 2-point locking

(iii) Technical Specifications - MNVR

Sl No	Parameter	Minimum Technical Specifications
1	Video Format	752 H x 582 V (PAL)
2	Number of Video Inputs	8channels
3	Number of Video Outputs	1 suitable
4	Number of Audio Inputs	8channels
5	Number of Audio Outputs	1
6	Video Compression Standards Supported	H.265+/ H.265, H.264, H.264+, MPEG-4, M-JPEG, Dual stream encoding
7	Audio Compression Standards Supported	At least any one of G.711, G.726
8	Number of streams	Dual streams, both streams independently configurable for each camera resolution and frame rate
9	Recording Resolutions	HD (720p/1080p)/WD1/4CIF/2CIF/CIF/QCIF(can be set independently for each channel, for both streams)
10	Video Frame Recording Rate	1 to15 fps for all channels at HD(total 60 fps) 1 to25 fps for all channels at4CIF (total 100 fps)

Sl No	Parameter	Minimum Technical Specifications
		resolution and frame rate can be set independently for each camera, for both streams
11	Alarm Sensors	Minimum 8inputs(NO/NC, configurable) 2 outputs
12	Storage	2 TB, 2.5” SATA Solid State Drive with suitable ant-vibration mechanism. Minimum 15 days of on-board storage Solid State Disk to be pluggable and easily removable, secure and protected by lock. mNVR should have storage capacity for at least 15days
13	Recording Modes	Normal, Schedule based, Alarm (via I/0 input e.g. Emergency Button, Emergency Door Open, Brake On, Reversing) triggered, Motion detection, Video loss, Camera Cover, Vehicle Speed, Threshold exceed on 6 axis Gyro, Recording On –Green mark, ‘Event’ Recording –Red mark
14	Transmission and Remote Monitoring of ‘Video surveillance’ data	Transmit over 4G and above, log on Server and Remote monitoring (Server/Client &iOS, Android Mobile Terminal) along with GPS Location on map. (see example under GPS requirements) Transmission Settings: Always On, SMS/Telephone Snap shot at configurable frequency Alarm (via I/0 input e.g. Emergency Button, Emergency Door Open,) Snap shot Estimated data/ Camera WD1, Quality 1=65KB CIF, Quality 4= 9KB
15	Event Based Recording And Tagging	Pre-recording–1to60 minutes Post-recording–1to30 minutes
16	Shut Down Delay	Configurable shutdown delay after ignition off up to 24 Hours
17	Power Input	9 to32 volts
18	Power output	Regulated power to CCTV cameras and Microphones and all other equipment used In the System
19	Working Temperature	-10 to 60 degree Celsius

Sl No	Parameter	Minimum Technical Specifications
20	Working Humidity	0% to 95% relative humidity
21	Network/Communication	LAN – 1 RJ45 interface 4 ports PoE (IEEE802.3af/at)/M12 connector Wi-Fi – 802.11/b/g/n
22	Interfaces	Wi-Fi–802.11/b/g/n 2.4 GHZ Access Point -10M for Data Download and System maintenance. Details as per Clause 5 Built-in3Gmodule, supportingboth2G and 3G (at least900,1800and2100MHzfrequency bands), Support for SMS, Voice, Data, GPRS, TCP/IP-External Antenna Built – in GPS Module-External Antenna
23	External Interfaces	1RS232, 1USB2.0, 1 Channel Pulse Speed Detection 1 SIM slot (Capable ofusingM2M Plastic, M2M RobustPlasticSIMandM2MIndustrialSIM) –To be mounted in a Lockable Compartment
24	Image quality	1 to 8 (configurable) In case of following Quality will automatically upgrade to 1(configurable): Alarm (via I/0 input e.g. Emergency Button, Emergency Door Open, Brake On, Reversing) triggered, Motion detection, Video loss, Camera Cover, Vehicle Speed, Threshold exceed on 6 axis Gyro
25	Watermark	Tamper-proof Watermark
26	Configurable Video Overwriting	Video over-writing to be configurable to support: Cyclicoverwriting (oldest recording to be overwritten) Configurable days/Capacity/never Event tagged recording not to be overwritten for a longer period (7 to 30days, configurable)
27	Connections	All input and output connections to be vibration/shock Resistant and locking. Desirable: Aviation Connectors
28	Installation	360 deg mounting position

Sl No	Parameter	Minimum Technical Specifications
29	LED Indicators	Power, Recording, 4G/ GPRSNetwork, Recording Error, Alarm, USB
30	IP Rating	Minimum IP53 with necessary ingress protection for antivibration on In Bus Environment
31	Test Compliances	As Detailed later in this document
32	Health Parameters over 4G & above SMS	Capable of sending health parameters (cameras not functioning, cameras tamper, SSD error, HDD/SSD full) at specified frequency to the server Capable of detecting failure, error or tamper of cameras or any component (Network Disconnected, IP Address Conflict, Illegal Login), Alarm (via I/0 input e.g. Emergency Button, Emergency Door Open) triggered, Video loss, Camera Cover, No SD Card, No Recording, Vehicle Speed, Vehicle acceleration (SDS) ‘ Camera cover’- sensitivity is configurable –common to all Camera and sending alert to severe mail and SMS to preconfigured contacts.
33	Safe Driving Solution (data logger) Driver Assessment Vehicle Health	Real Time data acquisition via 6 axis G sensor, Record on-MNVR, Playback, Transmit to Server on 4G & above: Driver behaviour Harsh Acceleration/ braking, Sharp Turns, collision. Real Time data acquisition, Record on-mNVR, Playback and Transmit to Server on 4G & above: Vehicle data - Vehicle Battery consumption, driving time, long idling, Load during trip (using weight sensors) Above functions to be using Interfaced unit as add-on to mNVR MIS Reports
34	Over-the-airUpdate/ Upgrade	Over-the-air update of configuration parameters of MNVRand cameras. Over-the-air upgrade of firmware The OTA updates will be based on Supplier Protocols
35	VideoDetection	Motion Detection, Video Loss & Camera Blank
36	RTC	Built-in RTC, drift not more than 10 seconds at any Time
37	Data Download and Configuration	MNVR should provide video and

Sl No	Parameter	Minimum Technical Specifications
	settings	audio download facility for the desired date/time and duration. It should be possible to connect a lap-top to MNVR through network cable on RJ45 port and open MNVR user interface in a standard browser using a standard URL such as http://nvr (or any other text specified by MoRTH) without having to configure the lap-top's network settings. After entering user-id and password (specified by MoRTH), it will be possible to search, view, select and download video clips of desired duration and date/time in standard formats such as .avi or .mpg. It will not be possible to delete any video or change configuration settings using this set of user-ID and password. Also, the data shall also be downloaded through remote login.
38	DataTransferon/4G & above	In case the vehicle moves to an area where /4G & above coverage is not present, the mNVR will automatically shift to GPRS (2G) connectivity to send the health status data. Also, in such case, on press of an emergency button, the mNVR will automatically shift to a lower frame rate and resolution (both configurable) and send the video from cameras to the backend server over GPRS (2G).
39	Integrated Applications / Software to be Supplied along with Equipment and all Protocol will be proprietary	Playback of Record on Storage Media Server/Client – 'Windows server 2012 R2 Standard' &iOS, Android Mobile Terminal Export of Server Log User and Evidence Management
40	ONVIF	ONVIF S & G Profile Compliant
41	Certification	BIS/UL, CE, FCC, EN50155, EN 61000, AIS004,IS16833
42	Open platform	The system should be open platform and not proprietary solution, it should have integration with at least 50 leading IP camera brands of the world (List of IP camera to be attached)

Sl No	Parameter	Minimum Technical Specifications
43	Analytics	Camera tampering Trigger based recording form Panic Button Head count for passenger count validation Facial recognition Driver behaviour detection
44	Panic button assistance	In the event of usage of panic button, mNVR shall share all in bus camera footages of total 60seconds over 4G and above to control centre. (60seconds = 30seconds before the pressing of button and 30seconds after the pressing of button)

Performance and Durability Testing & Environmental Test

Test Compliances for mNVR + Camera + GPS + Panic/SOS Button (together): Verification Report of ARAI/ICAT/CIRT is mandatory.

Sl No	Test standards compliance	Specifications
1	Performance parametric test	Nine points, tri temperature/tri voltage- 18V, 27V, 32V,-10°C, room temperature, +70°C test. At each test point the system will be powered on and shut down 5 times as per the supplier's designated procedure and thereafter evaluated for malfunction if any.
2	Cold	IS 9000 (Part II/Sec 4)-1977 (reaffirmed 2004) at -10^{o}C for 2 hours in 'on' condition
3	Dry heat	IS 9000 (Part III/Sec 5)-1977: at + 70^{o}C for 16 hours in 'on' condition.
4	Damp heat	IS 9000 (Part V/Sec 2)1981 at +25^{o}C /+55^{o}C, Humidity 95%, 24 hours for 6 cycles in off condition. Functional test with power in 'on' condition at start of 2nd, 4th and 6th cycle
5	Vibration, shock standard AIS 012/AIS:062 -10g	Frequency 5~55Hz and return to 5Hz at a linear sweep period of 1 minute/complete sweep cycle and 10g at maximum frequency Excursion -1.65 mm peak to peak over the specified frequency range Test duration 60 minutes Direction of vibration –X, Y, Z axis of device as it is mounted on the vehicle. Test to be carried out in 'on' condition as per ARAI EN 50155 or equivalent EN 50121 or equivalent
6	Dust and water ingress protection	IS /IEC 60947-1:2004 in conjunction with IS/IEC 60529:2001

Sl No	Test standards compliance	Specifications
7	Fire resistant harness	Horizontal Burning rate tested as per ISO 3795 , Flammability Test as per IS:2465:1984
8	Reverse polarity protection without fuse	The component must fulfill the function- and service life requirements after being subjected to reversed polarity up to 27 V for 2 minutes. ISO 17650-2.
9	Over voltage protection	To ensure service life requirements and functionality. The component shall run for 60 minutes at 36V, without effecting the service life or function. ISO 16750-2
10	Insulation resistance	The Insulation résistance measured as per ISO 16750-2 with avoltageof500 V dc shall not be less than 1 Mega ohm. Insulation Resistance Test will be carried out after completion of 'Damp Heat Test' and then the Test sample to be kept at room temperature for at least 0.5 hrs.
11	Salt spray test	(AIS: 012/ IS10250) 96 hours
12	Free fall (MNVRonly)	IS 9000 (Part VII/Sec 4) Free fall at 500 mm.
13	EMC/EMI	AIS 004 (PART 3)
14	Operating parameters	Supply voltage 24 V± 25%
15	Slow Increase and decrease (Ramp up/ Down)	Apply a Voltage of 0V to 27V at increasing rate of 0.5V per second for slow Increase of Power Supply. Apply a Voltage of 27V to 0V at decreasing rate of 0.5V per second for slow Increase of Power Supply.
16	ESD Test	Powered Direct Contact ± 6 kV, ± 8 kV Direct Air ± 8 kV, ± 15 kV Unpowered Direct Contact ± 6 kV ± 8 kV Direct Air ± 8 kV ± 15 kV
17	Endurance Test	Ambient Temperature, preferably 27 ± 2°C, 28 V, 100 000 cycles. Each cycle shall consist of switching ON & OFF the system with dwell time as follows: Dwell time: 10 s ± 1 s (ON condition), 4 s ± 1 s (OFF condition).
18	USB port over loading test	USB Port Pin No. 1 (+5 VDC) &Pin No. 4 (GND)to be Short Circuited with external wire in "ON" condition as shown below. The System should continue to work without any problem.
19	Improper Shut down	Battery supply shall be disconnected in the middle of operation. This shall be repeated for 100 times ON time :- 3~4 min, Off time :- 10 sec

ITS integration :

1) The Service provider shall maintain their own server from which the data shall be pushed to BMTC ITS application through Application Programming Interface (API). Further, all necessary software's required for integration shall be maintained by the service provider.
2) Real time GPS data, through Application Programming Interface(API) (Push) Protocol.
3) Panic/ SOS button when pressed, alert should go to BMTC servers and also 30 seconds video before and after panic/ SOS button press should be sent to BMTC server through API (Push) Protocol.
4) Availability of live streaming of video through API (Push) to integrate with BMTC application.
5) Manual video download option to be available through API (Push).
6) 4G & above SIM card for both ATD and mNVR to be provided by vendor along with data plan [ATD device (4G & above)-500 MB minimum per month and for mNVR (4G & above)-2 GB minimum per month]
7) Appointing one nodal person from vendor to co-ordinate with BMTC security department and police department to share mNVR camera footage when sought for.
8) Provide access to the data or fails to integrate with the BMTC ITS/AVLS shall be done with 45 days of commissioning of fleet. Penalty of Rs.500 per bus per week may be levied for failure.
9) If any partial data/no data/ delayed data / in accurate data is received from the devices, though the trip is operated completely, Penalty of Rs.500 per bus per week may be levied
10) Hardware Specification of ATD, mNVR& Camera's to be installed in bus is provided in the above table.
11) Service provider shall establish a command control Centre to monitor the operations and in turn shall share the monitoring report to BMTC on monthly basis, failing to which BMTC shall levy suitable penalty

Chief Mechanical Engineer